FORM PTO-1390 (REV. 11-2000)

U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	
0234-0421P	
U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	
09/786626 NEW	

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/01959	March 29, 2000	December 13, 1999

TITLE OF INVENTION

PRODUCTION OF HIGH-FUNCTION PHOTOCATALYST

APPLICANT(S) FOR DO/EO/US

TANAKA, Keiichi; VOHRA, Muhammad Sharing

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39 (1).
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is transmitted herewith.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4)
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 20. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98-International Search Report (PCT/ISA/210) with documents
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information:
    1.) PCT Request (PCT/RO/101)
    2.) Verification of Translation
    3.) Zero (0) sheets of Formal Drawings

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/786626 NEW	PCT/jP00/01959	0234-0421P

21. ☒ The following fees are submitted:		CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5):			
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	**$1,000.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	**$860.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	**$710.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	**$690.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	**$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =		**$ 860.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☒ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		**$ 130.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	12 - 20 =	0	X **$18.00**	**$**	**0**
Independent Claims	2 - 3 =	0	X **$80.00**	**$**	**0**
MULTIPLE DEPENDENT CLAIM(S) (if applicable)	Yes		+ **$270.00**	**$**	**270.00**
TOTAL OF ABOVE CALCULATIONS =				**$**	**1260.00**
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				**$**	**0**
SUBTOTAL =				**$**	**1260.00**
Processing fee of **$130.00** for furnishing the English translation later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				**$**	**0**
TOTAL NATIONAL FEE =				**$**	**1260.00**
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				**$**	**0**
TOTAL FEES ENCLOSED =				**$**	**1260.00**
				Amount to be: refunded	**$**
				charged	**$**

a. ☒ A check in the amount of $ **1260.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account. No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-2448.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send all correspondence to:
Birch, Stewart, Kolasch & Birch, LLP or Customer No. 2292
P.O. Box 747
Falls Church, VA 22040-0747
(703)205-8000

Date: March 7, 2001

By _____
Marc S. Weiner, #32,181

/cqc

VERIFICATION OF TRANSLATION

RE: INTERNATIONAL APPLICATION NO. PCT/JP00/01959

I, Toshizo Iida of ISHII Bldg. 3F, 1-10, Shimbashi 3-chome, Minato-ku, Tokyo 105-0004 Japan, am the translator of the documents attached and I state that the following is a true translation to the best of my knowledge and belief.

Signature of translator

Toshizo IIDA

Dated: March 6, 2001

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: TANAKA, Keiichi et al.

Int'l. Appl. No.: PCT/JP00/01959

Appl. No.: New Group:

Filed: March 7, 2001 Examiner:

For: PRODUCTION OF HIGH-FUNCTION PHOTOCATALYST

PRELIMINARY AMENDMENT

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, DC 20231

March 7, 2001

Sir:

The following Preliminary Amendments and Remarks are respectfully submitted in connection with the above-identified application.

AMENDMENTS

IN THE SPECIFICATION:

Please amend the specification as follows:

Before line 1, insert --This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/JP00/01959 which has an International filing date of March 29, 2000, which designated the United States of America.--

IN THE CLAIMS:

Please amend the claims as follows:

4. (Amended) The high-function photocatalyst according to claim 1 or 2, wherein the polymer having an anionic group is poly(fluorine-substituted sulfonic acid).

5. (Amended) The high-function photocatalyst according to claim 1 or 2, wherein the photocatalyst is spherical.

6. (Amended) The high-function photocatalyst according to claim 1 or 2, wherein the photocatalyst is immobilized on a substrate.

REMARKS

The specification has been amended to provide a cross-reference to the previously filed International Application. The claims have also been amended to correct improper multiple dependencies and to place the application into better form for examination. Entry of the present amendment and favorable action on the above-identified application are earnestly solicited.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By _____
Marc S. Weiner, #32,181

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

MSW/cqc
0234-0421P

Attachment: Version with Markings to Show Changes Made

(Rev. 01/22/01)

VERSION WITH MARKINGS TO SHOW CHANGES MADE

The specification has been amended to provide a cross-referencing paragraph to the International Application.

The claims have been amended as follows:

4. (Amended) The high-function photocatalyst according to [any one of claims 1 to 3]claim 1 or 2, wherein the polymer having an anionic group is poly(fluorine-substituted sulfonic acid) [(for example, Nafion)].

5. (Amended) The high-function photocatalyst according to [any one of claims 1 to 4]claim 1 or 2, wherein the photocatalyst is spherical.

6. (Amended) The high-function photocatalyst according to [any one of claims 1 to 5]claim 1 or 2, wherein the photocatalyst is immobilized on a substrate.

SPECIFICATION

PRODUCTION OF HIGH-FUNCTION PHOTOCATALYST

TECHNICAL FIELD

The present invention relates to a photocatalyst used, for example, in decomposition of harmful organic compounds, a method of manufacturing the same, and a photocatalyst that is obtained immobilizing said photocatalyst.

BACKGROUND ART

Wastewater that can be processed by a photocatalyst at a practical level is limited. This is because the processing efficiency of a current photocatalyst is not sufficient with regard to most harmful substances. To improve the efficiency, it is considered to carry platinum on the photocatalyst or dope with impurities, but the effect is inadequate, and stable results are not obtained in the latter method.

It is hence an object of the present invention to provide a high-function photocatalyst that exhibits high decomposition efficiency toward harmful materials and that can be used for a long time, and a method of manufacturing

the same.

Other and further objects, features, and advantages of the invention will appear more fully from the following description.

DISCLOSURE OF THE INVENTION

The present inventors, after intensive studies to solve the above problems, discovered that many harmful substances have a positive electric charge in water.

To decompose such harmful substances having a positive electric charge efficiently, it has been found that the photocatalyst should be brought into as closely to the harmful substances as possible, and hence the present invention has been completed.

That is, the present invention was accomplished based on the findings that a significant photocatalytic function is expressed toward harmful materials having a positive electric charge, when the surface of a spherical photocatalyst is partially covered with a polymer having an anionic group.

In the present invention, to cover the surface of a spherical photocatalyst partially with a polymer having an anionic group, the polymer having an anionic group is dissolved in a solvent, to dilute the concentration of the

polymer, and then the solution is evaporated and dried, so that the polymer can be entangled in parts of the surface of the spherical photocatalyst.

If the entire photocatalyst is covered with the polymer having an anionic group, chances of light and water existing simultaneously around the catalyst are lowered, and hence it is required that the catalyst should be exposed partially.

BEST MODE FOR CARRYING OUT THE INVENTION

The photocatalyst utilized in the present invention may be any photocatalyst that can be ordinarily used, and it is not particularly limited. Specific examples of the photocatalyst include titanium dioxide, zinc oxide, zirconium oxide, and tungsten oxide and the like, among them, titanium dioxide being preferred.

The photocatalyst may be used in a form of powder, immobilized powder or film prepared by sol-gel method or vapor deposition method. The shape of the photocatalyst is not particularly limited, and spherical, flat, tubular or fibrous shape may be used.

The photocatalyst, the polymer having an anionic group, and the solvent are mixed, stirred and dried, or alternatively the photocatalyst is immobilized on a glass plate, or natural or synthetic high polymer film or the

like, and a solution dissolving the polymer having an anionic group is applied and dried thereon. For example, the photocatalyst may be immobilized with a binder on the ceramic or plastic film. A diluting solvent of the polymer having an anionic group is not particularly limited if it may be any solvent capable of dissolving this polymer, and for example, methanol, ethanol, propanol and the like may be used.

The polymer having an anionic group includes poly(fluorine-subsutituted sulfonic acid) such as Nafion (tradename of Du Pont Company), poly(fluorine containing carboxylic acid) such as Flemion (tradename of Asahi Glass Company), polystyrene sulfonic acid, polyvinyl sulfonic acid and the like, and, among them, Nafion is particularly preferred because of its strong resistance toward decomposition of photocatalyst.

A linear polymer is preferred, and it is required to be insoluble in water and soluble in organic solvent, and the molecular weight is preferably about 500,000 to 1,000,000.

The amount to be used of the polymer having an anionic group is preferred to be 0.05 to 5 ml in a 5-% by weight solution per g of photocatalyst powder, and more preferably 0.1 to 0.4 ml. In the immobilized photocatalyst, it is preferred to be 0.1 to 1 ml of 5-% by

weight solution per surface area of 20 cm^2, more preferably 0.1 to 0.3 ml. The solution is mixed and applied to be uniform, dried at room temperature. Thus, a partial covering can be formed.

In the present invention, the surface of the photocatalyst is partially covered with the polymer having an anionic group. Herein, the partial covering means covering of the surface of the photocatalyst with the polymer so that at least a part of the photocatalyst surface may be exposed so as not to impede the catalytic function of the photocatalyst, and to attract the organic materials having positive ions around the catalyst enough electrostatically, by the anionic group of the polymer existing on the photocatalyst surface. In the present invention, the amount for use of polymer having an anionic group, used for partially covering the surface of the photocatalyst differs according to the concentration of the organic materials to be decomposed or the type of the photocatalyst, but may be set properly within the specified range depending on the situation.

The photocatalyst of the present invention is effective for harmful materials having positive ions. For example, amine compound, imine, pyridine compound and their salts and the like are particularly effective.

Using the photocatalyst of the present invention,

these compounds contained in water can be decomposed at high efficiency. The decomposition process can be conducted by that the wastewater to be treated is brought into contact with the photocatalyst, and irradiated with ultraviolet ray.

Applicable objects of the photocatalyst of the present invention are not limited to harmful substances in water, but include harmful gases, for example, gaseous amine.

The light source of irradiation is, preferably, a light source containing light of shorter wavelength than 380 nm. Such examples include low pressure or high pressure mercury vapor lamp, xenon lamp, halogen lamp, blacklight, and sunlight etc.

The mechanism why the photocatalyst of the present invention can decompose the organic materials having a positive ion efficiently is not fully understood, but it seems that the anionic group of the polymer existing on the surface of the photocatalyst attracts the organic materials having a positive ion to the photocatalyst, and that the hydroxyl radical released by the photocatalyst at a close distance efficiently attacks the organic materials having a positive ion.

The embodiments of the present invention may be summarized as follows.

(1) A high-function photocatalyst having its surface partially covered with a polymer having an anionic group.

(2) The high-function photocatalyst according to above (1), wherein the polymer is a linear polymer.

(3) The high-function photocatalyst according to above (1) or (2), wherein the photocatalyst is in a form of a fine powder with particle size of 0.04 to 1 μm.

(4) The high-function photocatalyst according to any one of above (1) to (3), wherein the polymer having an anionic group is poly(fluorine-substituted sulfonic acid) (for example, Nafion).

(5) The high-function photocatalyst according to any one of above (1) to (4), wherein the photocatalyst is spherical.

(6) The high-function photocatalyst according to any one of above (1) to (5), wherein the photocatalyst is immobilized.

(7) A method of manufacturing a high-function photocatalyst comprising the steps of adding a spherical photocatalyst into a solution having a linear polymer having an anionic group dissolved in a solvent, stirring, and drying.

(8) A method of manufacturing a high-function photocatalyst comprising the steps of immobilizing a photocatalyst on a substrate of a film or the like, for

example, with an adhesive, applying thereon a solution dissolving a polymer having an anionic group, and drying.

The photocatalyst of the present invention has been confirmed to decompose organic materials having a positive electric charge efficiently. The efficiency of the photocatalyst itself is also confirmed not to deteriorate for a long period.

Examples

Next, the present invention will be described in more detail based on examples given below, but the present invention is not meant to be limited by the following examples.

Example 1

To 0.2 ml of 5-% by weight commercial Nafion solution, 1 ml of methanol was added, and 2 g of titanium dioxide powder (mean particle size 0.15 μm) was mixed to the solution, and the mixture was dried overnight at room temperature. In 500 ml of 10^{-4} mol l^{-1} (26 ppm) solution of herbicide paraquat, 2 g of titanium dioxide covered with the above-described Nafion was suspended. The suspension was irradiated with a blacklight of 6 W placed in the center of the liquid. First, by stirring the suspension for 120 minutes without irradiation with light, 10% of the initial concentration of the herbicide was

decreased. Then, starting irradiation with the light, 75% of the concentration was decomposed after 20 minutes, and 100% of the concentration was decomposed in 90 minutes. In a comparative example of titanium dioxide without covering with Nafion, only 25% of the concentration was decomposed in 20 minutes and 55% of the concentration in 60 minutes.

Example 2

The same experiment as in Example 1 was conducted except that 2 ml of Nafion solution was used with 2 g of titanium dioxide. First, by stirring for 120 minutes without irradiation with light, 50% of the initial concentration of the herbicide was decreased. It is considered the result was due to adsorption. Later, by irradiation with the light for 5 minutes, only 3% of the concentration was detected.

Example 3

The same experiment as in Example 1 was conducted except that ethylamine of 10^{-4} mol l^{-1} (6.9 ppm) was used instead of paraquat. By irradiation with the light for 5 minutes, 55% of the initial concentration of the ethylamine was decomposed, and 80% of the concentration was decomposed in 10 minutes. In case of the titanium dioxide without covering with Nafion, almost nothing of the concentration was decomposed in the first 5 minutes,

and only 20% of the concentration was decomposed after 10 minutes.

Example 4

0.2 ml of 5-% by weight commercial Nafion solution was diluted with 0.5 ml of methyl alcohol, and the solution was applied uniformly on a titanium dioxide thin film prepared by sol-gel method on a glass plate of 45 x 45 mm, and the film was dried for 24 hours at room temperature. This dried plate was put into a cell made of Pyrex glass of 50 (width) x 50 (length) x 10 (thick) mm, and 15 ml of paraquat solution of 10^{-4} mol 1^{-1} was added therein, and the cell was irradiated with high pressure mercury vapor lamp of 500 W. First, by stirring for 90 minutes without irradiation with light, 10% of the initial concentration of the herbicide was decreased. Then, by irradiation with the light, 75% of the initial concentration was decreased in 60 minutes.

Example 5

To investigate the stability of covering Nafion film, the same experiment as in Example 1 was conducted by using deionized water instead of paraquat. In 27 hours without irradiation with light, 4.5 x 10^{-5} mol 1^{-1} of sulfuric acid ion and 3 ppm of TOC were detected, and there was almost no change of these concentrations until the end of 51 hours. It was considered that sulfuric acid ions were

derived from titanium dioxide, and TOC were derived from impurities in Nafion. Afterwards, for 19 days consecutively, irradiation with the light was continued, and samples were taken at proper time intervals. There was no change in sulfuric acid ions, but TOC decreased slightly. Within this time duration, the results suggest that Nafion is stable.

Example 6

To evaluate reproducibility of the above-described photocatalyst when used repeatedly, after the experiment of example 1, the photocatalyst in the suspension was collected, and a new solution of paraquat was added therein, and the irradiation to the suspension was conducted in the same condition. This operation was repeated 5 times, and the decomposition efficiency was measured each time, but deterioration of efficiency of photocatalyst was not detected.

INDUSTRIAL APPLICABILITY

The photocatalyst of the present invention is preferable as photocatalyst for decomposing organic materials having positive electric charge efficiently.

Having described our invention as related to the present embodiments, it is our intention that the

invention not be limited by any of the details of the description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

CLAIMS

1. A high-function photocatalyst having its surface partially covered with a polymer having an anionic group.

2. The high-function photocatalyst according to claim 1, wherein the polymer is a linear polymer.

3. The high-function photocatalyst according to claim 1 or 2, wherein the photocatalyst is in a form of a fine powder with particle size of 0.04 to 1 μm.

4. The high-function photocatalyst according to any one of claims 1 to 3, wherein the polymer having an anionic group is poly(fluorine-substituted sulfonic acid) (for example, Nafion).

5. The high-function photocatalyst according to any one of claims 1 to 4, wherein the photocatalyst is spherical.

6. The high-function photocatalyst according to any one of claims 1 to 5, wherein the photocatalyst is immobilized on a substrate.

7. A method of manufacturing a high-function photocatalyst comprising the steps of adding a spherical photocatalyst into a solution having a linear polymer having an anionic group dissolved in a solvent, stirring, and drying.

8. A method of manufacturing a high-function

photocatalyst comprising the steps of immobilizing a photocatalyst on a substrate of a film or the like, applying thereon a solution dissolving a polymer having an anionic group, and drying.

ABSTRACT OF THE DISCLOSURE

A high-function photocatalyst having its spherical surface partially covered with a polymer having an anionic group is disclosed. This photocatalyst has high efficiency in decomposition of harmful substances, and it is a high-function photocatalyst usable for a long period of time.

BIRCH, STEWART, KOLASCH & BIRCH, LLP

ATTORNEY DOCKET NO.
234-421P

PLEASE NOTE: YOU MUST COMPLETE THE FOLLOWING:

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT AND DESIGN APPLICATIONS

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated next to my name; that I verily believe that I am the original, first and sole inventor (if only one inventor is named below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Insert Title: ➡ PRODUCTION OF HIGH-FUNCTION PHOTOCATALYST

Fill in Appropriate Information - For Use Without Specification Attached: ➡

the specification of which is attached hereto. If not attached hereto,

the specification was filed on _____ as
United States Application Number 09/786,626 ; and /or

the specification was filed on March 29, 2000 as PCT
International Application Number PCT/JP00/01959 ; and was
amended under PCT Article 19 on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (six months for designs) prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as follows.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Insert Priority Information: (if appropriate) ➡

Prior Foreign Application(s)

(Number)	(Country)	(Month/Day/Year Filed)	Priority Claimed
11-353257	Japan	12/13/1999	☒ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

Insert Provisional Application(s): (if any) ➡

(Application Number) _____ (Filing Date) _____

(Application Number) _____ (Filing Date) _____

All Foreign Applications, if any, for any Patent or Inventor's Certificate Filed More Than 12 Months (6 Months for Designs) Prior To The Filing Date of This Application:

Insert Requested Information: (if appropriate) ➡

Country	Application No.	Date of Filing (Month/Day/Year)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Insert Prior U.S. Application(s): (if any) ➡

(Application Number)	(Filing Date)	(Status - patented, pending, abandoned)

I hereby appoint the following attorneys to prosecute this application and/or an international application based on this application and to transact all business in the Patent and Trademark Office connected therewith and in connection with the resulting patent based on instructions received from the entity who first sent the application papers to the attorneys identified below, unless the inventor(s) or assignee provides said attorneys with a written notice to the contrary:

Terrell C. Birch	(Reg. No. 19,382)	Raymond C. Stewart	(Reg. No. 21,066)
Joseph A. Kolasch	(Reg. No. 22,463)	James M. Slattery	(Reg. No. 28,380)
Bernard L. Sweeney	(Reg. No. 24,448)	Michael K. Mutter	(Reg. No. 29,680)
Charles Gorenstein	(Reg. No. 29,271)	Gerald M. Murphy, Jr.	(Reg. No. 28,977)
Leonard R. Svensson	(Reg. No. 30,330)	Terry L. Clark	(Reg. No. 32,644)
Andrew D. Meikle	(Reg. No. 32,868)	Marc S. Weiner	(Reg. No. 32,181)
Joe McKinney Muncy	(Reg. No. 32,334)	Andrew F. Reish	(Reg. No. 33,443)
C. Joseph Faraci	(Reg. No. 32,350)	Donald J. Daley	(Reg. No. 34,313)

16

Send Correspondence to: **BIRCH, STEWART, KOLASCH & BIRCH, LLP**

P.O. Box 747 • Falls Church, Virginia 22040-0747

Telephone: (703) 205-8000 • Facsimile: (703) 205-8050

PLEASE NOTE: YOU MUST COMPLETE THE FOLLOWING:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

(month/day/year)

Full Name of First or Sole Inventor: Insert Name of Inventor
Insert Date This Document is Signed
Insert Residence
Insert Citizenship
Insert Post Office Address

GIVEN NAME: **Keiichi** FAMILY NAME: **TANAKA** | INVENTOR'S SIGNATURE: Keiichi Tanaka | DATE*: 8/30/2001

Residence (City, State & Country): **Oita-shi, Oita, Japan** | CITIZENSHIP: **Japan**

POST OFFICE ADDRESS (Complete Street Address including City, State & Country): **c/o Oita University of 700 Dannoharu, Oita-shi, Oita, Japan**

Full Name of Second Inventor, if any: see above

GIVEN NAME: **Muhammad Shariq** FAMILY NAME: **Vohra** | INVENTOR'S SIGNATURE | DATE*

Residence (City, State & Country): **Nepean, Ontario, Canada** | CITIZENSHIP: **Pakistan**

POST OFFICE ADDRESS (Complete Street Address including City, State & Country): **76 Glade Crest Crt., Nepean, Ontario, Canada**

Full Name of Third Inventor, if any see above

GIVEN NAME FAMILY NAME | INVENTOR'S SIGNATURE | DATE*

Residence (City, State & Country) | CITIZENSHIP

POST OFFICE ADDRESS (Complete Street Address including City, State & Country)

Full Name of Fourth Inventor, if any see above

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POST OFFICE ADDRESS (Complete Street Address including City, State & Country)

* DATE OF SIGNATURE

BIRCH, STEWART, KOLASCH & BIRCH, LLP

PLEASE NOTE: YOU MUST COMPLETE THE FOLLOWING:

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT AND DESIGN APPLICATIONS

ATTORNEY DOCKET NO. 234-421P

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated next to my name; that I verily believe that I am the original, first and sole inventor (if only one inventor is named below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Insert Title: PRODUCTION OF HIGH-FUNCTION PHOTOCATALYST

Fill in Appropriate Information - For Use Without Specification Attached:

the specification of which is attached hereto. If not attached hereto,

the specification was filed on _____ as

United States Application Number 09/786,626 ; and /or

the specification was filed on March 29, 2000 as PCT

International Application Number PCT/JP00/01959 ; and was

amended under PCT Article 19 on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (six months for designs) prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as follows.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Insert Priority Information: (if appropriate)

Prior Foreign Application(s)

(Number)	(Country)	(Month/Day/Year Filed)	Priority Claimed	
11-353257	Japan	12/13/1999	☒ Yes	☐ No
			☐ Yes	☐ No
			☐ Yes	☐ No
			☐ Yes	☐ No
			☐ Yes	☐ No

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

Insert Provisional Application(s): (if any)

(Application Number) (Filing Date)

(Application Number) (Filing Date)

All Foreign Applications, if any, for any Patent or Inventor's Certificate Filed More Than 12 Months (6 Months for Designs) Prior To The Filing Date of This Application:

Insert Requested Information: (if appropriate)

Country	Application No.	Date of Filing (Month/Day/Year)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Insert Prior U.S. Application(s): (if any)

(Application Number) (Filing Date) (Status - patented, pending, abandoned)

(Application Number) (Filing Date) (Status - patented, pending, abandoned)

I hereby appoint the following attorneys to prosecute this application and/or an international application based on this application and to transact all business in the Patent and Trademark Office connected therewith and in connection with the resulting patent based on instructions received from the entity who first sent the application papers to the attorneys identified below, unless the inventor(s) or assignee provides said attorneys with a written notice to the contrary:

Terrell C. Birch	(Reg. No. 19,382)	Raymond C. Stewart	(Reg. No. 21,066)
Joseph A. Kolasch	(Reg. No. 22,463)	James M. Slattery	(Reg. No. 28,380)
Bernard L. Sweeney	(Reg. No. 24,448)	Michael K. Mutter	(Reg. No. 29,680)
Charles Gorenstein	(Reg. No. 29,271)	Gerald M. Murphy, Jr.	(Reg. No. 28,977)
Leonard R. Svensson	(Reg. No. 30,330)	Terry L. Clark	(Reg. No. 32,644)
Andrew D. Meikle	(Reg. No. 32,868)	Marc S. Weiner	(Reg. No. 32,181)
Joe McKinney Muncy	(Reg. No. 32,334)	Andrew F. Reish	(Reg. No. 33,443)
C. Joseph Faraci	(Reg. No. 32,350)	Donald J. Daley	(Reg. No. 34,313)

Send Correspondence to: **BIRCH, STEWART, KOLASCH & BIRCH, LLP**

P.O. Box 747 • Falls Church, Virginia 22040-0747

Telephone: (703) 205-8000 • Facsimile: (703) 205-8050

PLEASE NOTE: YOU MUST COMPLETE THE FOLLOWING:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

(month/day/year)

Full Name of First or Sole Inventor: Insert Name of Inventor Insert Date This Document is Signed

GIVEN NAME / FAMILY NAME: **Keiichi TANAKA** | INVENTOR'S SIGNATURE | DATE*

Insert Residence Insert Citizenship

Residence (City, State & Country): **Oita-shi, Oita, Japan** | CITIZENSHIP: **Japan**

Insert Post Office Address

POST OFFICE ADDRESS (Complete Street Address including City, State & Country): **c/o Oita University of 700 Dannoharu, Oita-shi, Oita, Japan**

Full Name of Second Inventor, if any: see above

GIVEN NAME / FAMILY NAME: **Muhammad Shariq Vohra** | INVENTOR'S SIGNATURE: Muhammad Shariq Vohra | DATE*: 9/5/2001

Residence (City, State & Country): **Nepean, Ontario, Canada** | CITIZENSHIP: **Pakistan**

POST OFFICE ADDRESS (Complete Street Address including City, State & Country): **76 Glade Crest Crt., Nepean, Ontario, Canada**

Full Name of Third Inventor, if any see above

GIVEN NAME / FAMILY NAME | INVENTOR'S SIGNATURE | DATE*

Residence (City, State & Country) | CITIZENSHIP

POST OFFICE ADDRESS (Complete Street Address including City, State & Country)

Full Name of Fourth Inventor, if any see above

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